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January 7, 1997

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Mr. William Caton
Acting Secretary
Federal Communications Commission
1919 M Street, N.W. - Room 222
Washington, D.C. 20554

Re: CC Docket 96-45, Federal-State Joint Board on Universal Service Proxy Cost Models

Dear Mr. Caton,

GTE hereby submits responses to selected questions posed to proxy cost model proponents in the Public Notice, DA 96-2091, released by the Federal-State Joint Board on Universal Service on December 12, 1996. In addressing technical aspects of the proposed proxy models, GTE is not altering its basic position on their use, as expressed in GTE's Comments dated December19, 1996, on the recommended decision of the Joint Board.

Sincerely,

W. Scott Randolph
Director - Regulatory Affairs

cc: Docket 96-45 Federal State Joint Board and Joint Board Staff
Ms. Sheryl Todd, Universal Service Branch, 2100 M Street (computer diskette)
ITS

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Before the
FEDERAL COMMUNICATIONS COMMISSION
Washington, DC 20554

Federal-State Joint Board on Universal Service	))	CC Docket No. 96-45

RESPONSES TO QUESTIONS ADDRESSED TO MODEL PROPONENTS BY THE FEDERAL-STATE JOINT BOARD ON UNIVERSAL SERVICE

Model revisions

2c. Switching:

The switching cost equation in the Hatfield Model, Version 2.2, Release 1 and Release 2, is based on three so-called data points, none of which is observable, and one of which is a mere guesstimate by an anonymous "expert". The other two data points are supposed to be regarded as much more solidly grounded in fact, because they are calculated from "publicly available" data sources. [1]

As can be seen from Figure 6, **Switching Investment Function**, from Release 1, the two line-segment equation passes through three price and line-size pairs: ($241, 2782), ($104, 11200), and ($75, 80000). The last one is the "data point" that is based on a price estimated by the anonymous expert, about which there is no more to say, and the first two are obtained as described below. In fact, none of the three points is data; there is no information in the model on the cost of any particular size of switch, or on how cost changes as a function of the demands on the switch.

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[1] In this case, "publicly available" means that the publication can be purchased for $5000 per copy from McGraw-Hill.

Column 4, Table 2.10 (Page 157) of the FCC's Statistics of Communications Common Carriers, 1994 Edition (herein after Statistics), contains numbers for the Seven Regional Bell Operating Companies' Total Switched Access Lines (112,215,811) and Total Central Office Switches [including remotes] (9,987), as of December 31, 1993. Dividing the former by the latter gives 11,236 (which Hatfield Associates rounds to 11,200), which is an estimate of the average line size of RBOC embedded switches at year-end, 1993. Column 5 (on Page 158) of that same table, contains similar numbers for Other Reporting Local Exchange Companies: 25,759,938 switched access lines and 9,260 Total Central Office Switches [again, including remotes]. Doing the same division as before gives 2,782 (which Hatfield Associates does not round), which is an estimate of the average line-size of the embedded switches of the Other Reporting LECs at year-end, 1993. (Note that in Release 2, the number 2,782 becomes 2,721 in Figure 9 **Switching investment curve** and 2,761 in the text on Page 24.)

Hatfield Associates then treats these average switch line sizes as if they corresponded to the average size, in terms of lines served, of new digital switches shipped in 1994, and links them with forecasts of prices to be paid in 1994 by RHCs ($105) [which becomes $104 in Hatfield] and Independents [other than GTE] ($241) to derive the first two "points" in the switching cost equation. Even if these averages were reasonably arrived at (about which more infra), simply combining them as Hatfield has done does not produce a valid observation of the cost of any particular size of switch. The fact that the average size of some large group of switches is x, and the average cost is y, does not imply that a switch of size x costs y. Any number of functions could yield the same average values, without passing through either of the two "points" derived in this fashion. Further, there is no basis for the functional form Hatfield has chosen to link the three "points" together. Yet the form chosen (piecewise linear in cost/line) has very strong implications for the values assigned to other switch sizes. For example, the Hatfield equation would suggest that a 400 line switch could be purchased for about $100,00. In sum, the Hatfield equation is not based on any valid information about either the cost level associated with any particular switch size, or about the relationship of cost to switch size.

Aside from their lack of relevance, the accuracy and consistency of the Hatfield data are also suspect. Hatfield assumes that the composition of new switches shipped in 1994 is the same as the composition of the embedded base of switches. GTE is excluded from the Independents, even though GTE is obviously included in Other Reporting LECs in Statistics, and a specific price forecast for GTE ($119) is contained in the table which is the source for the $105 and the $241 figures.[2]

The price forecasts cited above are contained in Exhibit 3.34: Line and Trunk Prices, 1993-1998, in the publication U.S. Central Office Equipment Market - 1994, which is prepared by Northern Business Information (NBI), a division of McGraw-Hill. The corresponding price forecasts for 1995, in that same exhibit, are $102 for RHCs and $236 for Independents (again, other than GTE). Hatfield Associates uses these figures in Release 2 of - Version 2.2, but adjusts them, as will be discussed below. Prices forecast for 1996-1998 display a continuing gradual decline.

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[2] Since Statistics contains Total Switched Access Lines and Total Central Office Switches data for GTE telcos, this mismatch could have been avoided.

According to Mr. William L. Hahn, Inquiry Analyst at NBI, these prices represent the engineered, furnished and installed cost of new digital switches having a 5:1 line to trunk ratio (Telephone conversation with Dr. Lawrence P. Cole, GTE Laboratories Incorporated, October, 1996), but they do not include the cost of trunk ports (See letter to Ms. Robin Sanders, Bell Atlantic, September 20, 1996). This latter point is particularly relevant, because in Release 2, the "adjustment" that Hatfield Associates makes to the per-line prices contained in Exhibit 3.34 for 1995 is to subtract $16 per line for trunk ports, which then appears in the interoffice facilities module. But subtracting it from where it wasn't and adding it in elsewhere, still leaves it out.

As Mr. Hahn's letter to Ms. Sanders makes clear, the NBI estimates are not based on a model nor a lot a data. Rather, they are based on interviews with carriers and vendors by the NBI analyst (who is no longer with the firm), and on public contract announcements. There is no way of knowing what the carriers and vendors, both of whom normally regard prices paid for switches as highly proprietary, as has been demonstrated in several recent regulatory proceedings, revealed to the NBI analyst. But it should be possible to go back and look at public contract announcements in the period 1991-1994 and see what information they contained. Of particular interest would be the extent to which the contracts were for comparable packages of hardware, software and labor. One such announcement was made by Pacific Bell in January 1993. It covered 9 million lines and worked out to about $110 per line, but the contracts excluded investments for line terminations, main distribution frames, and fiber interfaces. Did the NBI analyst know this? What adjustments did he make for it? We simply don't know.

The NBI analyst didn't confine himself to forecasting prices, however; he also discussed the marketing strategies of the vendors and the nature of the market for digital switches. In those areas his views seemed to square with common knowledge in the industry: initial hardware typically sells at loss leader prices, but additional lines and software upgrades for enhanced services sell at premium prices. Thus, a model which looks only at initial hardware costs, and ignores growth, as the Hatfield Model does, is going to underestimate switching investment.

From the point of view of the purchaser, there are two reasons why it is absolutely essential to take into account the growth forecast over the life cycle of switches: (1) in order to properly compare bids from different vendors, and (2) in order to properly rank projects that are competing for scarce investment funds. The net present value calculations made to compare bids or prioritize projects have to include the costs and timing of the additional lines, of the software upgrades, and of any additional hardware required to offer enhanced services. The companies' capital planning models routinely use this approach and have done so for years. Similarly, the RAND Model (1990)[3] incorporated growth into its analysis in general, and the UK Model recently developed by Yogesh Sharma at Brunel University, London,[4] demonstrates how the assumed growth rate in the number of lines to be served and the length of the planning horizon determine the right-sizing of the initial switch installation.

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3 Incremental Costs of Telephone Access and Local Use, Bridger W. Mitchell, RAND, July 1990

4 "Network Development: Telecommunications Cost Analysis", Appendix 2 to Kosten, Ingo Vogelsang, 1996

Not taking growth into account also results in the switching cost estimates in the Hatfield Model being problematical in other ways. For example, if one examines the data in Statistics, which Hatfield relies on, the average line size of RBOC embedded switches, as calculated in the manner illustrated above, has grown from 10,316 in 1988 to 12,030 in 1995, with most of it having occurred since 1992. Since the RBOCs serving areas have not been significantly changed by acquisition, merger or sale over that period, their approximately 20% increase in switched access lines, from 98,292,660 in 1988, to 119,912,794 in 1995 can probably be safely interpreted as exogenous growth. That growth in lines served was only accompanied by an increase of about 4.6% in the number of RBOC reported switches, from 9528 in 1988 to 9969 in 1995, so lines served per switch perforce increased.

If the number of lines served per installed switch is increasing over time due to exogenous growth, then the typical embedded switch is larger than it was when it was first installed; i.e., newly shipped switches are smaller on average than embedded switches. Thus, the $104 price from the NBI table is probably associated with a too large switch. By the same token, the average size of Other Reporting LECs embedded switches has declined from 3734 in 1988 to 2077 in 1995, but here the definitions of the reporting entities have been changing by more than enough to be just noise in the system, so it is not easy to sort out what's been going on, except that for both Other Reporting LECs and RBOCs, one trend is clear: the share of remotes in Total Central Office Switches has been increasing dramatically (from 7666 in 1991, to 15708 in 1995, for All Reporting LECs), which means that remotes must have been the majority of what has been shipped in that period. But the NBI exhibit doesn't really have any remotespecific prices, all of which reinforces the point that what is needed are some real switch cost data from either carriers or vendors or both.

Finally, with respect to data, let it be noted that the FCC's Statistics contains a not minor error for 1994. The published figures for Total Central Office Switches figures for the five Ameritech companies double counted their remotes, thereby increasing the RBOC total by 717, and decreasing the average line size of RBOC embedded switches from 11551 to 10776. So much for "publicly available" data.

As the RAND model demonstrated, much of the cost of a central office switch can be attributed to lines, trunks, busy hour traffic and busy hour call attempts, but after as much as can be so assigned has been, there remains a large, fixed lump of common cost, which shows up as the intercept term in the switching cost equation. That lump is just for the EF&I cost of the switch, and does not include the land and building cost, which is also shared by all services that use the switch.

In the Hatfield model, the switching cost equation has no intercept term and no coefficients for trunks, traffic or call attempts. In the BCM2, there are five size ranges of C.O. switches, each with an intercept term in the hundreds of thousands of dollars, and with a constant per line cost of $100, but with no trunk, traffic or call attempts variables. Neither model, therefore, has any analytic basis for attributing any cost to usage.

16)

Overhead Costs

Overhead costs, by definition, are shared by all the outputs of the firm, and, hence, in current usage, are common costs. Some of them may be wholly unrelated to production and are incurred simply because the firm exists. They frequently are regarded as fixed in the short run, but in the long run are variable, as are all other costs. In the long run context, variable may mean only adjustable, or avoidable, but not continuously variable with output. Thus, when Hatfield Associates say that general and administrative expenses don't meet the economist's definition of overheads because they vary with the size of the firm (as a percentage of revenues), they are simply wrong.[5]

Prior to Release 1, Hatfield Associates argued that these overheads should be set at 6%, because they claimed that's what the overheads were in automobile and aircraft manufacturing, which are competitive industries, and hence they were appropriate for the LEC industry. Their view was that since these overheads consisted of expenses for the Administrative, Planning, Legal and Human Resources departments, the level should be about the same across all industries.[6]

When it was pointed out to Hatfield Associates that their sponsors, AT&T and MCI, reported corporate overheads about twice that percentage, they came up with a new number, 10% and a new rationale in Release 1, where it is described as having been obtained by regressing Corporate Operations expense, reported in ARMIS 43-02 Holding Company data, on total revenues, less Corporate Operations expense.[7]

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5 "The Cost of Basic Network Elements: Theory, Modeling and Policy Implications", Hatfield Associates, March 29, 1996, P. 30

6 Ibid.

7 Hatfield Model Version 2.2, Release 1, Page 51.

In Release 2 (P. 87), there was a new explanation for the 10% figure: "Based on studies of these variable support expenses in competitive industries, such as the interexchange industry". However, the Hatfield Model V.2.2.2. - Input Summary (P. 2) says "The factor is based on a regression analysis of the Tier 1 LECs' ARMIS G&A ("overhead") expenses and all other costs". This regression has never been made public, so there is no way of knowing whether it is econometrically reasonable, or what the results were before they were adjusted downward "to include efficiencies resulting from operating in a competitive environment," or what these adjustments were.

<u>More smoke; No Fire</u>

The 10% "variable support" factor in Release 2 is also described as having been obtained by doing something like "activity analysis", in order to determine what quantities corporate overheads varied with respect to. In testimony, Hatfield witnesses describes what was done as "capturing the corporate operation expenses that vary with levels of demand". That is not what "activity analysis" is and it is not what Hatfield Associates has done.

GTE has reviewed the activity analysis literature and related recently published research findings on overhead costs. What activity analysis, or activity based costing (ABC) and activity based management, undertakes to do is identify drivers of indirect costs, those drivers being "activities" such as machine set-ups, engineering work orders, hospital admissions, etc., and not volumes of output. The objective is to find substitutes for direct labor hours or direct machine hours, which are widely used as the basis for allocating indirect costs to individual products or services.[8]

The motivation for looking for multiple cost drivers is the belief that the use of a single cost driver "standard costing system" misleads management into thinking that in manufacturing, for example, volume drives overheads, when, in fact, it's the diversity of the product line, the number of batches run, and the complexity of the production process. Evidence to support this view has been reported for automobile, electronics and machinery manufacturing, where the manufacturing overheads alone amount to 26% of total costs,[9] and in the airline[10] and hospital industries,[11] and at British Telecom.[12] In no case is anyone running a simple regression of overhead costs on adjusted revenues.

Validation of the Models

The proof of an economic model is in its predications, whether it's a cost model,

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[8] Kennedy, Allison; "ABC basics", Management Accounting, June 1996, pp. 22C24.

[9] Banker, Rajiv D., Gordon Potter and Roger G. Schroeder, "An empirical analysis of manufacturing overhead cost drivers", Journal of Accounting and Economics 19 (1995), pp. 115-137.

[10] Banker, Rajiv D. and H. H. Johnson; "An empirical study of cost drivers in the U.S. airline industry", The Accounting Review, July 1993, pp. 576.

[11] Noreen, Eric and Naomi Soderstrom; "Are overhead costs strictly proportional to activity? Evidence from hospital services departments", Journal of Accounting and Economics 17 (1994), pp. 255-278.

[12] Bussey, B. A.; "ABC within a service organization", Management Accounting, December 1993, pp. 40-41, 65.

a model that predicts how many customers will buy a new product at a specific price, or a model that forecasts the unemployment rate in the U.S. economy. When models have been around for a while, they acquire a "track record", i.e., a compilation of how their predictions have compared with the actual magnitudes. If their performance turns out to be unsatisfactory, the models are either sent back to the drawing board or discarded. The usual assumption, then, is that if a model's predictions are at wide variance with what happens in the real world, it is not the real world that's wrong.

When new models are first introduced, they don't have much of a track record, if any. Of course, if they are econometric models, they at least have the within-sample goodness of fit that can be evaluated. The top-down model from Strategic Policy Research is of that type and reports the standard goodness of fit measures. Bottom-up, engineering process models, such as BCM2, CPM and Hatfield, not being based on statistical data, can't be evaluated in such terms. But their predictions can be compared with current real world data.

The claim by Hatfield Associates that their model's estimates can't be compared with current actual costs because their model estimates future costs is false. Time is not explicitly taken into account in the Hatfield model, so there is no point in time in the future with which its predictions can be associated.[13] None of these models are dynamic simulation models; they contain no "laws of motion" that get them from one time period to the next.

The further claim by Hatfield Associates that the explanation for the wide

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[13] BCM2 and CPM are similar in this respect.

discrepancies between its cost estimates and current actual costs of the ILEC is waste and inefficiency is an assertion for which there is no corroborating evidence whatsoever. Not even in the days of only rate-of-return regulation did any competent empirical study ever find significant evidence to confirm the "Averch-Johnson effect". The economics journals stopped publishing the no-findings results and researchers stopped pursing it.[14]

In fact, actual and forward-looking costs are not simply unrelated to one another. They certainly can differ, but they will do so for reasons which can be identified, and reconciled.

The current placement costs modeled by the proxy models can be compared directly to records of the costs of new placements being made by the ILECs this year. Embedded costs, which include the sum of past investments, will differ from current costs if the depreciation applied to investments from prior years has not fully captured changes in input prices or the effects of changes in technology. If economic depreciation has been correctly applied, the value of past investments on the books of the company should be consistent with the costs of newly placed equipment.

Thus, while embedded costs may differ from forward-looking costs, they can, and should, be reconciled as part of the validation process. Any discrepancy between the model's output and actual cost data cannot be dismissed simply by assuming that reality is wrong.

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[14] Subsequently, several parties, including the sponsors of the Hatfield model, have argued that rapid gains in ILEC productivity should justify a higher productivity offset in the price cap formula. Thus, according to these parties, the ILECs are simultaneously inefficient and highly productive.

Besides comparing the Hatfield Model's cost estimates with actual costs currently incurred by real telephone companies, and comparing them with estimates produced by other models, there are other indicators of whether the model's estimates should be regarded seriously. One such indicator would be their use by some actual or potential facilities-based entrant in its capital planning. There has been no evidence offered that any firm contemplating becoming a CLEC is basing its decisions on these numbers.

One of the Hatfield Model's sponsors, AT&T, has submitted estimates to the FCC of what it thinks it would cost a new entrant to build a competitive network and how long it would take to do it. In the April 19th NPRM, the FCC cited AT&T numbers: \$1288 in local exchange market capital investment per line, in order to reach 20% of the RBOC's (circa 1994) approximately 117.3 million switched access line customers. In aggregate, that translates in to about \$28.5 billion, and that figure was compared with AT&T's annual capital budget of just under \$5 billion to make the point that if AT&T were to spend its entire capital budget on facilities-based CLEC entry, it would take six years just to be able to contest one-fifth of the RBOCs market share, which is about 81% of the total of the Tier 1 LECs.

That \$1255 investment per line figure is within a few dollars of figures that appear commonly as the average investment per line estimated by BCM2 for Census Block Groups in the second lowest of the six density zones used in that model. The BCM2 estimates, are of course, considerably higher than those generated by the Hatfield Model.

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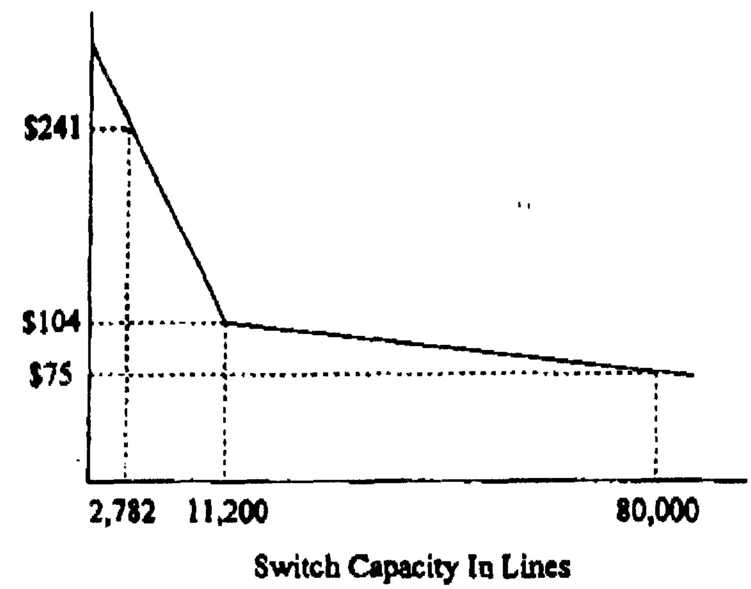
Figure 6 Switching Investment Function



The wire center module uses existing tandem locations for computing interoffice transmission distances. These tandem locations are obtained from the LERG data. Tandem and operator tandem switching investment are computed according to assumptions contained in an AT&T report on interexchange capacity expansion costs filed at the FCC.[32] The investment calculation assigns a price to switch "common equipment," switching matrix and control structure and adds to these amounts the investment in trunk interfaces. The numbers of trunks and their related investments, are derived from the transport calculations described below.

Wire center investments required to support end office and tandem switches are based on HAI assumptions about the size of room required to house a switch (for end offices, this size varies according to the line sizes of the switch), construction costs, lot sizes, land acquisition costs and investment in power systems and distributing frames.

The model computes required wire center investments separately for each switch. For wire centers housing multiple end office switches, the wire center investment calculation adds switch rooms to house each additional switch. Tandem wire center

[32] AT&T, "An updated study of AT&T's Competitors' Capacity to Absorb Rapid Demand Growth", filed with the FCC in CC Docket No. 79-252, April 24,1995 ("AT&T Capacity Cost Study")

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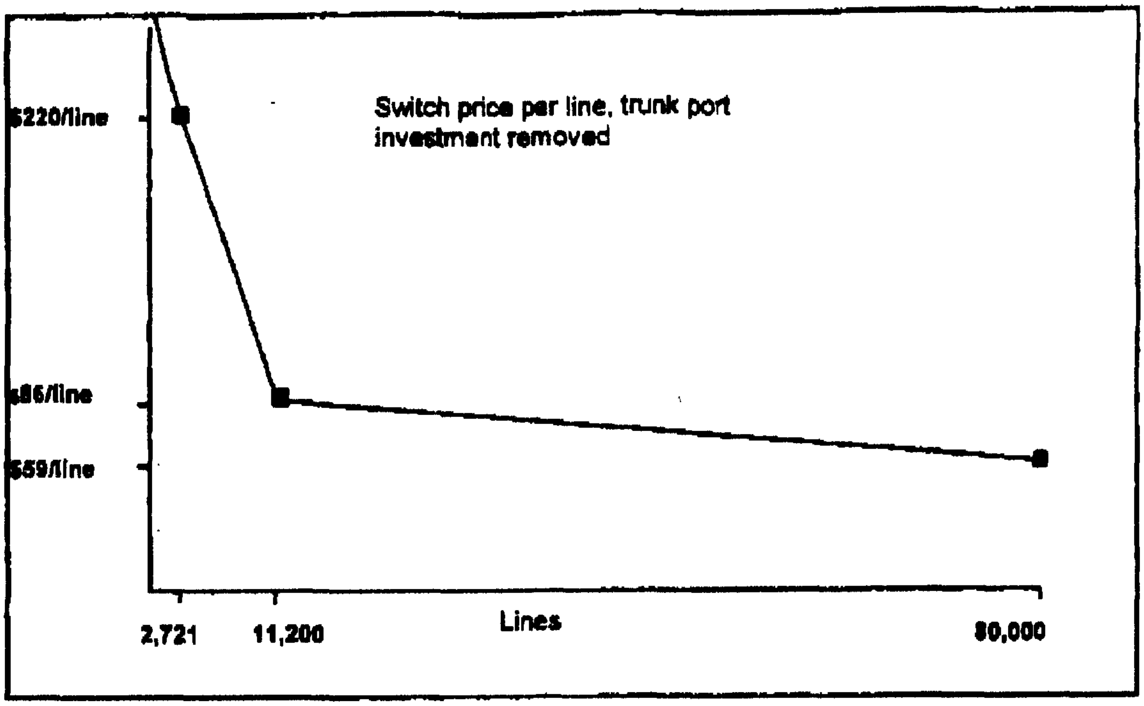

Figure 9 Switching investment curve

The wire center module uses existing tandem and end office wire center locations for computing interoffice transmission investments. A preprocessing step, relying on licensed LERG data, produces end office-to-tandem, end office-to-STP, tandem-to-STP, and STP-to-STP distances in a table that then is used by the module to estimate interoffice transmission facility investments. The module computes investments for end office and tandem "A" signaling links, "C" signaling links between the STPs in a mated pair, and it estimates investments in "D" signaling link segments that an interconnecting carrier such as an IXC may lease from the ILEC.

Tandem and operator tandem switching investments are computed according to assumptions contained in an AT&T report on interexchange capacity expansion costs filed with the FCC.[31] The investment calculation assigns a price to switch "common equipment," switching matrix and control structure, and adds to these amounts the investment in trunk interfaces. The numbers of trunks and their related investments, are derived from the transport calculations described below. The module recognizes that a significant fraction of local tandems also perform end office switching functions, and the inputs allow the user to vary the

[31] AT&T, "An Updated study of AT&T's Competitors' Capacity to Absorb Rapid Demand Growth," filed with the FCC in CC Docket No. 79-252, April 24, 1995 ("AT&T Capacity Cost Study").

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P. 1

NORTHERN BUSINESS INFO.

BA-NJ
Exhibit 8

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Wm. L. Hahn, Inquiry Analyst
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1221 Avenue of the Americas, 37th Floor
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September 30th, 1996

Ms. Robin Sanders
Bell Atlantic
1717 Arch Street, 22nd Floor
Philadelphia, PA 19103

Ms. Sanders:

Based on our recent conversations, I am writing now to clarify our methodology in the matter of compiling the *U.S. Central Office Equipment Market DB* for 1995. Your inquiry concerned the RBOC cost per lines for switches in 1995, the sum of $[illegible]. This figure was arrived at by our analyst through interviews with the carriers and vendors, supplemented by information drawn from public contract announcements. As an example, public announcements from the RBOC's over the period 1991-1994 show a drop in price per line. No formal model was employed; our analyst made an estimate based on such data. It should be noted that this figure does not include the cost of trunk ports. Further information about the driving forces behind these assumptions can be found in the introduction to that report, which I enclose for your convenience.

I hope this information will be of service to you in this matter. If there is more that I may be able to help you with, please don't hesitate to contact me.

Regards,

Wm. L. Hahn

Wm. L. Hahn